Canberra Health Services
Guideline
Electrolyte Replacement Guidelines (Adults)

Contents

Guideline Statement

Background
This document has been developed to describe and guide the best practice for electrolyte replacement in adult patients across Canberra Health Services (CHS).

Key Objective
This document aims to:

- Provide guidance to clinicians on the safe and appropriate use of oral and intravenous electrolyte replacement for potassium, phosphate, magnesium and calcium
- Describe the products that are available across CHS and how to safely prescribe and administer them
- Document the expected standard for intravenous electrolyte prescribing and administration in the context of replacement therapy.

Alerts
Concentrated electrolytes, in particular potassium, are high risk medications, which means if an error is made in dispensing, preparation or administration it is more likely to lead to patient harm. To prevent causing avoidable harm to patients, extra care must be taken when prescribing and administering electrolytes, particularly via the intravenous route. All staff should follow the standards for storage and use of intravenous potassium described in the *Medication Handling Policy*.

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Scope

The Clinical Guideline "Electrolyte Replacement in Guidelines (Adults)" applies to nursing, pharmacy and medical staff caring for adult patients of the Canberra Health Service.

The following are out of scope:

- Administration of electrolytes to patients in the Intensive Care Unit or Resuscitation Bay of the Emergency Department
- Administration of electrolytes in emergency conditions such as asthma and cardiac arrhythmia
- Management of sodium abnormalities is complex and is out of scope for this guideline
- Electrolyte replacement for paediatric patients
- Patients with complex alterations in electrolyte balance, acid base status, renal function or disturbance of other components of plasma.

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Section 1 – Potassium

1.1 High-risk Medication[1]

The administration of intravenous (IV) potassium is a potentially dangerous procedure:

- Errors in calculation or admixture of concentrated potassium containing solutions can result in serious adverse reactions and even death.
- IV bolus administration of concentrated potassium can be lethal.
- When high concentrations are used, even minor divergence from the recommended rate of administration can be cardiotoxic.

The expected standard of practice is to prescribe pre-mixed potassium containing infusion bags. There are pre-mixed bags available to suit almost all clinical situations and it is MANDATORY for these to be considered as the first option.

Preparation of a boutique potassium containing solution for intravenous infusion is a high-risk process and not recommended due to the following risks:

- Errors in calculation of potassium additive, leading to confusion regarding the final concentration.
- Inadequate mixing of potassium and infusion, leading to pooling of the potassium additive and inadvertent potassium bolus.

Additional potassium chloride **MUST NEVER** be added to a pre-mix potassium bag and **MUST NEVER** be added to hanging or running IV bags.

Prescribe electrolytes by writing the **FULL NAME** (and salt). Chemical abbreviations are not acceptable e.g. potassium chloride (NOT KCl).

The standards for storage and use of intravenous potassium is described in the *Medication Handling Policy*.

1.2 Potassium Replacement Recommendations[1-8, 13]

Check magnesium levels – repletion of magnesium stores will facilitate more rapid correction of hypokalaemia.

Serum Potassium	Route	Potassium Dosage	Monitoring Required
Mild Deficit: Serum Potassium: 3.1 – 3.5 mmol/L	Oral	• Potassium chloride slow release tablets: 2 tablets (16 mmol K^+) BD or TDS **OR** • Potassium chloride effervescent tablets: 1-2 tablet (14-28 mmol K^+) BD or TDS	Daily serum potassium ECG not required
Moderate Deficit: Serum Potassium: 2.5 – 3.0 mmol/L	Oral (preferred)	• Potassium chloride slow release tablets 3 tablets (24 mmol K^+) TDS **OR**	Serum potassium at least every 6-12 hours

Serum Potassium	Route	Potassium Dosage	Monitoring Required
	AND/ OR IV	• Potassium chloride effervescent tablets 2-3 tablets (28-42 mmol K^+) TDS **AND/OR** **IV Peripheral Line (rate not to exceed 10mmol/hr)** • 30 mmol potassium chloride in 1000mL pre-mixed bag **OR** • 10 mmol potassium chloride in 0.29% sodium chloride (isotonic) pre-mixed bag (100mL)	ECG is required if symptomatic (arrhythmia, marked muscle weakness or rhabdomyolysis)
Severe Deficit: Serum Potassium: Less than 2.5 mmol/L	Oral ***AND*** IV	• Potassium chloride slow release tablets: 3 tablets (24 mmol K^+) TDS **AND/ OR** • Potassium chloride effervescent tablets 2 tablets (28 mmol K^+) TDS **AND** **IV Peripheral Line (rate not to exceed 10mmol/hr)** • 10 mmol potassium chloride in 0.29% sodium chloride (isotonic) pre-mixed bag (100mL) **OR** **IV Central Line (rate not to exceed 20mmol/hr without continuous ECG monitoring)** • 10 mmol potassium chloride in 0.29% sodium chloride (isotonic) pre-mixed bag (100mL)	Serum potassium every 4-6 hours ECG required

Note: Information on the use of potassium acetate is not included in this guideline. This should only be used for potassium replacement in critical care areas.

1.3 Available Oral Potassium Supplements in CHS

Gradual replacement of potassium (via oral route) is preferred, if clinically appropriate since the relatively slow absorption from the gastrointestinal tract prevents sudden large increases in plasma potassium concentrations.

If a patient is fluid restricted, ALWAYS consider giving potassium via the oral route.

Potassium Chloride Product	Potassium content	Brand Names
Slow release tablet	8 mmol (600 mg)	Span K®
Effervescent tablets	14 mmol	Chlorvescent® (Dissolve in 100-150mL water)

Potassium Chloride Product	Potassium content	Brand Names
Oral mixture	20 mmol (1.5g) in 15mL	Potassium chloride Oral Mixture 10% w/v® (Note: Reserved for paediatric patients unable to tolerate Chlorvescent® preparation)

Note: Potassium citrate products are also available but are indicated for the prevention of kidney stones and increasing urine pH.

1.4 Available Pre-mixed Potassium Bags for Intravenous Infusion

The pre-mixed potassium bags for intravenous infusion available at CHS are detailed in the table below.

Potassium (mmol)	Fluid	Volume	Order From
10	0.29% sodium chloride (isotonic)	100 mL*	Pharmacy
20	0.45% sodium chloride and 5% glucose	1000 mL	
30	0.18% sodium chloride and 4% glucose	1000 mL	Supply Services, Mitchell
	5% glucose	1000 mL	
	Hartmann's solution	1000 mL	
	0.9% sodium chloride	1000 mL	
10	0.45% sodium chloride and 2.5% glucose	500 mL	

**The isotonic formulations contain a different concentration of sodium chloride to the other pre-mixed bags. This enables safe peripheral administration. The same concentration cannot be made with normal saline (sodium chloride 0.9%) bags.*

Note:

- Information on using potassium dihydrogen phosphate should be reserved for phosphate replacement and can be found in the Phosphate section of this document.
- 0.9% sodium chloride is the preferred infusion fluid as 5% glucose may cause trans-cellular shift of potassium into cells[5].
- Monitor the injection site closely due to the risk of phlebitis[5].
- Supply of potassium chloride 10 mmol/10 mL ampoules as imprest is restricted to the Intensive Care Unit, Operating Theatres, the Resuscitation Bay in the Emergency Department, and Paediatric High Care and this stock is not to be provided to other patient care areas. All staff must refer to the standards for storage and supply of intravenous potassium stated in the *Medication Handling Policy*.

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Section 2 – Phosphate

2.1 Phosphate replacement recommendations[2-6, 9, 13]

There are no national guidelines for the treatment of acute hypophosphataemia and practice varies widely across Australian hospitals. The use of phosphate for other indications such as re-feeding syndrome or use in the critical care setting is out of scope and, specialist advice should be sought.

Concomitant hypocalcaemia should also be corrected before treating hypophosphataemia to prevent further hypocalcaemia.

Serum Phosphate	Route	Phosphate Dosage	Monitoring Required
Mild Deficit: Serum Phosphate: 0.5 - 0.75 mmol/L	Treatment not usually required as can be treated by increasing dietary intake of food high in phosphate (e.g. dairy products), except if alcoholism/ withdrawal, malnutrition, re-feeding syndrome, receiving TPN, renal phosphate wasting, recovery from DKA or respiratory failure.		
Moderate Deficit: Serum Phosphate: 0.3 - 0.49 mmol/L	Oral **OR** IV (if symptomatic)	• Effervescent phosphate tablet 500mg* (Phosphate Sandoz®): 1- 2 tablets (16.1 – 32.2 mmol phosphate) up to TDS **OR** **IV Peripheral Line (Administer over 2-6 hours)** • 10 mmol potassium dihydrogen phosphate (KH_2PO_4) in 0.9% sodium chloride pre-mixed bag (250mL) **OR** • 10 mmol sodium dihydrogen phosphate (NaH_2PO_4) in 250mL 0.9% sodium chloride **Dose may be limited by diarrhoea*	Daily Serum phosphate & calcium
Severe Deficit: Serum Phosphate: Less than 0.3 mmol/L	IV	**IV Peripheral Line (Administer over 2 hours)** • 10 mmol potassium dihydrogen phosphate (KH_2PO_4) in 0.9% sodium chloride pre-mixed bag (250mL) **OR** • 10 mmol sodium dihydrogen phosphate (NaH_2PO_4) in 250mL 0.9% sodium chloride	Serum phosphate & calcium every 6-12 hours

2.2 Available Oral replacement

Phosphate Product	Phosphate content	Brand Names
Effervescent tablets*	16.1 mmol (500mg)	Phosphate Sandoz®

** Tablet should be dissolved in approximately 75mL of water and taken orally.*

2.3 Available Intravenous replacement

Form	Electrolyte Content	Availability
Potassium dihydrogen phosphate (KH_2PO_4)	10 mmol potassium and 10 mmol phosphate in 0.9% sodium chloride pre-mixed bag (250 mL)	Pre-mixed bag available from Pharmacy and afterhours CNC
Sodium dihydrogen phosphate (NaH_2PO_4)	10mmol sodium and 10mmol phosphate in 10mL vial	Vial available in Pharmacy and afterhours CNC.

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Section 3 – Magnesium

3.1 Magnesium replacement recommendations[2-6, 10, 11, 13]

Serum Magnesium	Route	Magnesium Dosage	Monitoring Required
Mild to Moderate Deficit: Serum Magnesium: 0.4 – 0.7 mmol/L	Oral	• Magnesium aspartate (500 mg)* 1 to 2 tablets (1.54 – 3.08 mmol) BD. Up to 6 tablets (9.24mmol) daily in divided doses may be required. **Dose may be limited by diarrhoea*	Daily or second daily serum magnesium
Severe Deficit: Serum Magnesium: Less than 0.4 mmol/L **OR** Symptomatic (e.g. tremor, weakness, cardiac arrhythmias, convulsions)	IV	**IV Peripheral Line** • 10 to 20 mmol magnesium sulphate ($MgSO_4$) in 100mL 0.9% sodium chloride over 1 hour*. Repeat if necessary, at 4 hourly intervals according to response. **Maximum infusion rate 36 mmol/hour.*	Serum magnesium levels or clinical symptoms within 6 to 12 hours.

Note: Hypomagnesemia may cause concomitant refractory hypokalaemia and hypocalcaemia, ongoing monitoring and replacement of all electrolytes is required

3.3 Available Oral replacement

Form	Approved Name	Magnesium content	CHS Restriction
Tablet	Magnesium aspartate*	500mg (1.54mmol per tablet)	n/a
Oral solution	Magnesium Chloride	1mmol/mL (100mL)	Restricted for paediatric patients with narrow bore NG/PEG tubes.

**Poor oral absorption*

3.4 Available Intravenous replacement in CHS[5]

Form	Electrolyte Content	Availability
Magnesium sulphate ($MgSO_4$) 2.5 g/ 5mL concentrated ampoule	10 mmol magnesium sulphate in 5 mL	Vial available in Pharmacy and afterhours CNC.
Magnesium sulphate ($MgSO_4$) 5 g/ 10mL concentrated ampoule	20 mmol magnesium sulphate in 10 mL	

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Section 4 – Calcium

4.1 Calcium replacement recommendations[2-6, 12, 13]

Remember plasma calcium (even corrected for albumin) is an unreliable measure of functional (ionised) calcium.

If resistant to treatment, exclude hypomagnesaemia.

Serum Calcium	Route	Calcium Dosage	Monitoring Required
Mild Deficit: Serum corrected calcium: 1.90 - 2.10mmol/L	Oral	• Calcium carbonate 1500mg (elemental calcium 600mg) 1-2 tablets (15-30mmol) daily.	Serum calcium second daily
Moderate Deficit: Serum corrected calcium: 1.5 - 1.89 mmol/L	Oral	• Calcium carbonate 1500mg (elemental calcium 600mg) 2-3 tablets (30-45mmol) BD-TDS.	Serum calcium daily
Severe Deficit: Serum corrected calcium: Less than 1.5 mmol/L or 0.75mmol/L ionised	IV	**IV Peripheral Line/ central line** • Calcium Gluconate 10% (10 mL vial)	Serum calcium at least every 4 hours

Serum Calcium	Route	Calcium Dosage	Monitoring Required
OR **Symptomatic hypocalcaemia** (e.g. perioral/ finger paraesthesia, seizures, tetany, positive Chvostek's/ Trousseau's)		1 to 2 vials (2.2 to 4.4 mmol) in 100 mL 0.9% sodium chloride over 20 to 30 minutes **THEN** • Calcium Gluconate 10% (10mL vial) 10 vials (22 mmol) in 900 mL 0.9% sodium chloride at 50 mL/hour	

4.3 Available Oral replacement

Calcium Product	Calcium content	Brand Names
Calcium Carbonate tablet	1500mg (elemental calcium 600 mg)	Caltrate®, Calci-Tab 600®, Cal-600®

4.4 Available Intravenous replacement

Form	Electrolyte Content	Availability
Calcium Gluconate	10% (2.2 mmol/10 mL)	Vial available in Pharmacy and afterhours CNC.

Note: Calcium gluconate is preferred to calcium chloride as it is less toxic to peripheral veins. Extravasation of calcium can cause localised skin necrosis.

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Evaluation

Outcome

Safer prescribing and administration, and standardised process for prescribing potassium, phosphate, magnesium and calcium

Measures

Monitoring and review of incidents associated with electrolyte replacement for potassium, phosphate, magnesium and calcium.

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Related Policies, Procedures, Guidelines and Legislation

Policies

- CHS Consent and Treatment
- CHS Medication Handling Policy
- CHS High Risk Medicines Policy

- CHS Patient Identification and Procedure Matching Policy

Procedures

- CHS Pathology requests and specimens Procedure
- CHS Patient Identification and Procedure Matching Procedure

Legislation

- Medicines, Poisons and Therapeutic Goods Act 2008
- Medicines, Poisons and Therapeutic Goods Regulation 2008
- Therapeutic Goods Act 1989
- Therapeutic Goods Regulation 1990

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References

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Definition of Terms

- K+ = Potassium
- KCl = Potassium chloride
- PO_4^- = Phosphate
- KH_2PO_4 = Potassium dihydrogen phosphate
- NaH_2PO_4 = Sodium dihydrogen phosphate
- Mg^{2+} = Magnesium
- $MgSO_4$ = Magnesium sulphate
- Ca^{2+} = Calcium
- Hypokalaemia = Low potassium
- Hypophosphataemia = Low phosphate
- Hypomagnesaemia = Low magnesium
- Hypocalcaemia = Low calcium

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Search Terms

Potassium, Hypokalaemia, Phosphate, Hypophosphataemia, Magnesium, Hypomagnesaemia, Calcium, Hypocalcaemia, Electrolyte

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Policy Team ONLY to complete the following:

Date Amended	*Section Amended*	*Divisional Approval*	*Final Approval*
16/09/2020	*Complete Review*	*Ashwin Swaminathan, ED Medical Services Group*	*CHS Policy Committee*

This document supersedes the following:

Document Number	*Document Name*
CHHS12:028	*Potassium Replacement Prescribing and Monitoring - Adult*